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PORT No. 11.

U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF FIBER INVESTIGATIONS.

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# A REPORT

ON THE

# CULTURE OF HEMP IN EUROPE,

INCLUDING

## A SPECIAL CONSULAR REPORT ON THE GROWTH OF HEMP IN ITALY, RECEIVED THROUGH THE DEPARTMENT OF STATE.

BY

CHARLES RICHARDS DODGE,
*Special Agent.*


WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1898.

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# LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF FIBER INVESTIGATIONS,
*Washington, D. C., June 1, 1898.*

SIR: I have the honor to submit herewith the manuscript of a report on the culture of hemp in Europe, which has been prepared in order to acquaint the hemp growers of this country with the foreign practices by which high grade imported hemps are produced.

The growth of a grade of American hemp that will sell for 6 to 8 cents per pound, instead of 3 to 3½ cents per pound, as at the present time, means that our farmers must follow more closely the careful practices of Europe, and especially that they must adopt water retting in place of the present practice of dew retting, which gives a fiber dark in color and uneven in quality. A careful consideration of the practices of Italy and France as set forth in this report will materially aid those who desire to change their product from the cheaper dark hemps, for which there is small demand, to the higher-priced light hemps, which will compete with the imported commodity.

I wish especially to call attention to the report, given herein, of United States Consular Agent Gardini, on the growth of Bologna and Ferrara hemp, and to state that it has been impossible, until recently, for the Department to secure any information regarding the growth of Italian hemp, which is recognized as the highest grade of hemp that comes to this country. The present widespread interest in hemp culture in the Southern States and in States west of the Mississippi makes the publication of this material at this time most desirable.

Respectfully,

CHAS. RICHARDS DODGE,
*Special Agent, in charge of Fiber Investigations.*

Hon. JAMES WILSON,
*Secretary of Agriculture.*

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# CULTURE OF HEMP IN EUROPE.

## INTRODUCTORY.

The cultivation of hemp in the United States is a very old industry, and at one period in our history was a very large one, the annual production in 1859 reaching a total of nearly 75,000 tons. But there has been a decline since this point of highest production was reached. In 1879 the annual production for the entire country had fallen to a point as low as 5,000 tons, then rising to about 12,000 tons; two or three years ago it again fell to 5,000 tons, but in view of the recent widespread interest in the growth of the plant, production is now increasing.

Many good reasons have been cited for this decline, which need not be enumerated here, further than to state that serious injury was done to the industry at the time when jute began to be used for bagging in lieu of flax and hemp, about 1872. For a long time the average annual production of the country amounted to about 12,000 tons, but with the lowering of prices, and with a failing demand for the kind of hemp that was grown, the subsequent decline to 5,000 tons was a most natural sequence. The low prices that have prevailed for sisal and manila fibers during the past few years have been factors in this decline, though the fact may be stated differently. The kind of hemp grown was so low in grade that it was simply crowded to the wall by better fibers.

Within two or three years, since the Office of Fiber Investigations has been advocating better methods of culture, and since California and the South have become interested in the production of hemp, the reaction has set in; there has been an effort to improve quality, with the result that fiber worth 6 and 8 cents per pound has recently been sent to the Eastern markets, and now the interest in hemp culture is extending in many parts of the country where hitherto it was unknown.

The coarse hemp of Kentucky and Illinois, 3½-cent fiber, if it may be so referred to, is dew retted, dark in color, not carefully prepared, and fit only for the commonest uses in manufacture. For this kind of hemp there is now a very small demand. The imported hemp, the Italian particularly, is water retted, light in color, some of it almost white, is carefully prepared, and the best of it capable of use in some of the manufactures for which fine flax is employed. This may be termed 8-cent hemp, and it is the kind of hemp that American growers should produce, and for which there is a large demand.

In a recent report issued from this office[1] detailed statements are made regarding the cultivation of hemp in the United States, but in view of the present widespread interest in the subject, and the necessity for improving the quality of fiber produced by better methods of culture and preparation, it is essential that our farmers should know something of the methods employed in countries where the best hemp is grown. To meet this necessity the present report has been prepared, and the author presents an account of the practices followed in France and Italy, because the hemp of these countries is the finest grown, although it should be stated that French hemp is largely consumed at home and rarely finds its way to the United States.

There are other imported hemps, such as the Russian and the Hungarian, the former, while lower in grade than either the French or the Italian, being imported into this country in considerable quantity and occupying a place in grade between the American and the Italian.

This office has examined many specimens of native hemp during the past season, submitted for expert opinion or otherwise; some of them were the results of first experiments in the direction of better culture, but all gave substantial evidence of improvement in quality, while a few specimens showed that it may be possible in the future to even compete with the Italian.

## KINDS OF HEMP GROWN.

The native home of hemp, known botanically as *Cannabis sativa*, is that part of Asia consisting of India and Persia, but it is now in general cultivation in temperate and tropical climes throughout the world.

Several varieties are recognized in cultivation in this country, that cultivated in Kentucky, and having a hollow stem, being the most common. China hemp, with slender stems growing very erect, has a wide range of culture. Smyrna hemp is adapted to cultivation over a still wider range, and a variety is beginning to be cultivated in California known as Japanese hemp, but which is doubtless identical with China hemp. In Europe five varieties are cultivated, which are enumerated as follows: The common hemp, grown largely in France and generally in Europe outside of Italy, growing to a height of 5 to 7 feet; Bologna hemp, known in France as Piedmontese hemp, or Great hemp, an Italian variety averaging 12 feet in height; Chinese hemp, known in Europe since 1846, and said to have been imported by Signor Itier;[2] the *Cannapa piccola*, or small hemp of Italy, with a reddish stalk, which is found in the valley of the Arno and around Tuscany; and the Arabian hemp, known as Takrousi, a short species cultivated for its resinous principle, from which hasheesh is derived.

[1] Report No. 8, Fiber Investigations series, on the culture of Hemp and Jute in the United States.

[2] It is stated that in Algiers this hemp has been grown to a height of 20 feet, and that its fiber is remarkably fine and wonderfully elastic.

## A PLANT OF UNIVERSAL GROWTH.

The culture is very old in China and Japan, the hemp of the latter country being remarkably fine and strong. It grows throughout India, ascending the Himalayas even to 10,000 feet elevation. It flourishes in tropical Africa on both the east and west coasts, and is found to some extent in the interior. It has been naturalized in portions of Australia, and thrives in several South American countries, while in North America it can be grown from the Gulf to Canada and from the Atlantic to the Pacific.

In Europe the culture is confined chiefly to France, Italy, Germany, Hungary, and central and southern Russia, though it grows in Holland and Belgium and has been cultivated in parts of Great Britain and in Sweden. The Italian culture is largely confined at the present time to the provinces of Bologna and Ferrara, the French to the northwestern districts, or Breton, France, while the chief producing districts of Russia are Orel, Koorsk, and Smolensk, and the Polish provinces. The plains of Hungary are said to be peculiarly adapted to the culture, and the Hungarian product is strong and good. As to the mere matter of growth, there is hardly a locality in Europe where the plant may not be cultivated, and the same holds good in the United States, where in many sections it has escaped from cultivation and masquerades as a native weed, all of which tends to prove that hemp is a plant of easy growth.

## THE HEMP INDUSTRY IN FRANCE.

Toward the latter part of September, 1889, the author visited the hemp region of western France, spending a week in different localities in the departments of Sarthe and Ille-et-Vilaine, the hemp culture of this country being carried on for the most part in the section of France known as Brittany.

It was interesting to learn that there was a large demand for hemp for spinning purposes, smaller now than formerly, because cotton has come into such universal use, but still enough to make quite an industry in the production of hemp "linen" alone. This manufacture includes shirtings, sheetings, and similar "white" goods, canvas, and a number of coarse fabrics which find a ready market. Some of the fabrics examined, which had not been bleached, were creamy in color, and so firm and durable that one readily understands why they still furnish employment to the Breton peasants in their domestic economy. The larger demand for hemp fiber in this section, however, is for the manufacture of cordage, the seat of this manufacture, and the seat of the hemp industry as well, being Angers, in the department of Maine-et-Loire. For lack of time Angers was not visited, and it was hardly important that it should have been, as all necessary information could be obtained in the localities that were visited. Methods of culture and of handling the product after harvesting are practically the same as were followed

many years ago, a gradual decline in quantity produced being the principal change that may be noted in the industry.

Probably the finest hemp is produced in Italy. The French hemp resembles this somewhat in color, both being a creamy yellow and soft and fine. The Russian and American hemps differ from these, being for the most part dark in color and not so fine in quality, though it is possible to improve the quality by better methods in both countries. While there is room for improvement in our own country, it would seem unnecessary to produce a hemp for spinning into fabrics to compete with flax manufactures when there should be a good home demand for a large quantity of coarse hemp, and the flax industry in the United States needs encouragement for the production of a grade of fiber for the very fabrics that hemp would enter into. Nevertheless, it is interesting to know how the French hemp is produced, and the main purpose of the investigations was to obtain information in this direction for the benefit of American farmers.

The prominent departments of France where hemp is cultivated are Maine-et-Loire, Sarthe, Morbihan, Isére, and Puy-de-Dôme. The two varieties cultivated are the common hemp of the country and the Italian hemp, the seed of which is obtained at Piedmont, the chief difference being in the length of the stalk, in slower development, and in its coarser quality, making it better adapted for cordage.

Climate has much to do with the successful cultivation of this plant, as it makes the best length of stalk, and therefore gives a greater yield of fiber, in those situations where the climate is mild and the atmosphere humid. Limestone soils or the alluvial soils, as found in the river bottoms, are most congenial to its growth, and as this portion of France is well watered by rivers or smaller streams, the cultivation is quite general along their banks. Such soils in our own country have given the best results. A rotation of crops is practiced, hemp alternating with grain crops, although MM. Girardin and Du Breuil state that it is also allowed to grow continually upon the same land. Regarding this mode of cultivation, they consider that it is not contrary to the law of rotation, as by deep plowing and the annual use of an abundance of fertilizers the ground is kept sufficiently enriched for the demands which are made upon it. If the soil is not sufficiently rich in phosphates or the salts of potassium, these must be supplied by the use of lime, marl, ground bone, animal charcoal, or ashes mixed with prepared animal compost. Even hemp-cake, the leaves of the plant, and the "shive" or "boon," may be returned to the land with benefit. This high fertilizing is necessary, as "the hemp absorbs the equivalent of 1.500 kilos of fertilizers per every hundred kilos of fiber obtained."

### PREPARATION OF THE LAND.

As in flax culture, a thorough preparation of the seed bed is important, and the finer and more mellow the ground the better will be the

fiber. The first plowing is done in summer after the harvest of the previous crop, for hemp is not considered an exhaustive crop, and is frequently grown upon the same land for a succession of years. The writer was not able to witness any of the agricultural operations in this industry, as it was late in the season, but the plowing is thus described:

The earth is thrown up so as to form two trenches of 0.30 meter (about 1 foot) in width, letting it fall over a strip of ground likewise of 0.30 meter in width, and which is completely covered by the earth thus thrown up. The heat at this season is sufficient to soon destroy the weeds contained in the earth thus treated. Ten or fifteen days later a roller is passed over the ground to level it, and a portion of the fertilizer is spread; then about 2½ hectoliters[1] of beans are sown to form a green compost. After this a second plowing is given, but in a reverse manner from the first, that is to say, the strips of ground which had been left at the first plowing are now turned over. The roller is again passed over the rough earth and draining ditches are made to prevent any moisture from hindering the plowing, which should terminate the series of operations at the end of autumn. This last tilling is done when the beans are 16 to 18 inches high and before the frost.

The harrow and roller are used to mellow and compact the soil, and small lines of trenches or furrows are dug for drainage purposes, these leading into the transverse ditches. These lines are about 10 feet apart. No further preparation is needed until the time for sowing the seed. Just before this time arrives the ground is worked over to kill the weeds, and is again harrowed. The seed is sown in drills, and covered lightly with a hoe, the soil being pressed down and made compact with this implement. The sowing occurs in the north of France about the last of April. The best fertilizers to use in hemp culture are ground bone, animal charcoal, lime, marl, and compost mixed with ashes. It is considered an advantage, likewise, to return to the soil the leaves and woody matter after cleaning, as well as the water in which the stalks were retted, when this is possible.

### QUANTITY OF SEED TO SOW PER ACRE.

The best seed comes from Piedmont, and, as it deteriorates rapidly, it is frequently renewed. The closer the plants can be grown the better the fiber, and to this end a large quantity of seed is used. A farmer in Sarthe informed the writer that the usual custom was to sow 60 liters of seed to 44 ares, 40 ares being equal to an acre. This would give as the proper rate to sow about 1½ bushels to the acre, though 4 bushels are sometimes put in where very fine fiber is desired. The sowing is done about the last of April.

[1] The area was not stated, but it is supposed that this quantity was for a hectare, which would be equivalent to 2¾ bushels of beans to the acre.

As the seed must be sown quite thickly to produce fine hemp, it deteriorates rapidly and involves the necessity of frequently renewing the seed; this causes a considerable expense. In order to retard as much as possible this impairing of the quality, there are a certain number of feet, upon the borders of the field, thinned out, and maize, beet root, etc., sowed, so that the plants, being isolated, may acquire a large development and the seeds produce plants which will preserve the proper characteristics of their species. The good seed is of a dark-gray color, glossy and heavy. It preserves its germinating power but one year.

When the ground hardens too rapidly, after sowing and before the plants have started, straw is sometimes strewn over the field, or the rake used to keep the surface open.

As in flax culture, the crop must be kept free from weeds; all injured plants must be removed, and it is the custom even to thin out the plants when growing too thickly, as is frequently the case from irregular sowing. It was learned that 250 plants to a square meter[1] of ground is considered the right average when the fiber is grown for cordage; but when produced for fabrics at least 400 plants are allowed to grow in this area. Full details of the manner of harvesting the crop at the farms visited were not obtained, but some facts as to the methods of harvesting are condensed from a French work[2] furnished the writer by M. Grosjean, of the ministry of agriculture.

### GATHERING THE CROP.

In order to obtain the best possible results in the quality of fiber, the plants should be gathered when the male stalks have shed their flowers and the stems begin to be yellow. Regarding the sex of the plant, the authors state in a footnote that "in many localities they give the name of male hemp to those plants which bear the fruit, and that of female hemp to those which have no fruit, a less development, and in which the vegetation is sooner arrested. This nomenclature is incorrect, as precisely the contrary (terms) should be employed."

The season of shedding the flowers comes in the west of France about the middle of July. There are two modes of gathering, dependent upon the use to which the fiber will be put. If for cordage, the stalks are cut with a sharp instrument resembling a short scythe, and laid upon the ground in sheaves, where they are left to dry from one to three days. The leaves are then stripped and the stalks removed to the sheds to be assorted, placed in piles horizontally, the lower ends of the stalks being pressed firmly against a wall, so that the inequalities of their length may plainly appear. Upon each pile there is placed close to the wall a weight, to prevent deranging the stems while drawing them out in assorting. This is done by handfuls: first the

[1] A meter is about 39⅜ inches over a yard.

[2] A Treatise on Agriculture, by Messieurs Girardin and Du Breuil.

longest stems, then the medium, and then the short ones. They are bound into sheaves, several of which are put together, forming bundles, each containing stalks of equal length. The tops of the sheaves are then cut off, and only the portion preserved that will make good fiber.

When the hemp is grown for use in spinning, that is, for fabrics, the stalks are not cut, but are pulled like flax. The operator first removes the leaves by passing his hand from top to bottom of the stalk, it being important to return the leaves to the soil where they were grown. Six to fifteen stalks are pulled at one operation, according to the ease with which they can be drawn out of the ground, and the earth shaken off. These handfuls are made into bundles about 6 inches in diameter; after bundling, the roots and tops are cut off by means of an ax and chopping-block. The clipped stalks are then made up into larger bundles a foot or more in diameter, and are sent to be retted at once, as it is claimed that the hemp is not so white if it is dried before retting.

### SAVING THE SEED.

In some localities the gathering of the hemp is so managed as to secure the greatest quantity of seed possible of good quality. To this purpose the male stalks are first collected, which ripen six weeks earlier than the female stalks, the latter being given plenty of time to mature and not being gathered until their leaves and stems begin to turn yellow and the seeds to grow dark. They are tied in bunches, and of these there are made large bundles, which are placed upright, that the seed may complete its opening. The seeds are extracted by beating the stalks. This manner of operating produces less fiber, and these female plants yield fiber of inferior quality from those collected at the time of maturing of the male plants; but the harvest of seed compensates for the difference. If you take into account the expense occasioned by the double harvesting and double retting, we find that there is greater advantage in having but one harvest, without reference to the seed. Dried in the air, the male hemp contains an average of 26 per cent of stripped hemp, and the female plants from 16 to 22 per cent. The stripped hemp dried in the air does not yield more than 60 to 75 per cent of textile fiber, the remainder being foreign matter soluble in leached alkali, so that 100 parts of green hemp do not produce more than 5 to 8 parts of textile fiber.

### RETTING THE STALKS.

There are two systems of retting practiced in western France, the retting in the open field, where the stalks are allowed to lie about a month, and similar to the plan followed in Kentucky, in our own country, and the water retting, which produces the best fiber. The water retting (rouissage) is accomplished both in pools and in running streams. The river retting seems to accomplish the best results, although taking a little longer time than the pool retting, the duration of immersion

varying from five to eight days. If the weather is cold it retards the operation two or three days longer than if warm. This accounts, too, for the shorter time occupied when the immersion takes place in pools. This work is usually done in the latter part of August. The bundles of hemp are floated in the water, secured if in a running stream, and are covered with boards kept in place by stones or any weight that will keep them under. From all that could be learned there is little pool retting in the Sarthe district, although public opinion is generally against river retting, on the score of its rendering the waters of the streams foul and detrimental to health, as well as destroying all animal life with which they should abound. There are said to be very stringent police regulations against the use of streams for this purpose, and as long ago as 1886, in a brochure published by M. Bary, a hemp spinner of Le Mans, attention was called to the desirability of introducing an improved method of retting, which would accomplish all the beneficial results of retting in running water artificially, and therefore render unnecessary the polluting of streams. From M. Janvier (of the hemp-spinning establishment of Janvier, Pere et Fils et Cie, at Le Mans, successors to M. Bary) it was learned that while many attempts have been made to bring about a better system, none have been successful, and, police regulations to the contrary notwithstanding, the best hemp fiber produced in the Sarthe district is still retted in the running streams.[1] Where pool retting is followed the pools are specially constructed, dug out of the earth to the depth of a yard or more, walled up or the sides made solid, and lined and floored with cement usually, in order that the water shall remain clean and the hemp retain its color. The stalks are watched very closely after the third or fourth days, the farmer breaking and examining a few at intervals to guard against over retting, which weakens the fiber.

When sufficiently retted, whether the work is done in streams or pools, the hemp bundles are removed from the water, but first agitated to remove all waste matter that may be adhering to the stalks. They are then drained, and the bundles, opened at the bottom, are set up in conical sheaves to dry, this operation being accomplished in two or three days. Considerable of the hemp grown in the Sarthe district (the writer can not speak for other sections) is further dried in brick-kilns. One of these examined on a large hemp farm visited near Le Mans, and at that time in operation, may be described as a circular brick structure some 10 or 12 feet in height, resembling a smokehouse in our country. It was built on a side hill, the door opening into the chamber where the hemp was drying being on one level, the higher, while the floor to the fire pit, at the opposite side of the building, was on the lower level. As no evidence of a fire was observed, it is inferred that the fire is drawn when the right temperature has been reached, and

[1] Such an improved process has recently been invented in Belgium, known as the Loppens-Deswarte system, and fully described in Report No. 10, Fiber Investigations Series. It is applicable alike to hemp and to flax retting.

the hemp introduced upon the grated floor to dry slowly by moderate heat. The writer witnessed the process of breaking hemp in the Sarthe district and brought away samples of both stalks and cleaned fiber as sent to market, as well as samples of scutched, softened, and dressed fiber prepared both for cordage manufacture and for weaving into "linen." The stalks are of creamy whiteness, as brittle as pipestems, and the filasse, particularly next the wood, so bright in color that no tinge of yellow is observable. A farm operator, upon being questioned, stated that he was able to break out 30 to 35 kilograms of fiber per day (say 60 to 75 pounds). A brake similar in principle to the old-fashioned Kentucky hemp brake is used, though lighter and smaller in the first place, produced with seven instead of five breaking slats (arranged three opposite to four), both wood and metal being used in its construction. Double this quantity of hemp is cleaned in a day by the negro operators in Kentucky, but it should be explained that the French operator is nicer in his manipulation of the fiber, running through a smaller quantity at one time, skillfully twisting the product into a very loose rope or "streak" of fiber, these as produced being laid most carefully side by side so that when the larger bundle of fiber is made up each has its place and can be detached from its fellows by the scutcher with hardly the disarrangement of a filament.

### SCUTCHING.

At a scutch mill, where, by the way, only hand scutching was practiced, the writer was shown some bales of softened fiber, and he afterwards visited the establishment of a hemp softener (Batteur de Chanvre), near Le Mans, to observe the process. The mill was run by water power, the fiber being manipulated on a circular platform a couple of feet in height and perhaps 8 in diameter, made of solid oak blocks placed on end and forming the surface. To a heavy spindle in the center was attached a short conical cylinder of iron, weighing some 2,400 pounds. The "streaks," or ropes, of fiber as received from the farmer are made up into bundles weighing perhaps 6½ pounds each, and these to the amount of 130 pounds are arranged over the surface of the circular bed, or platform. The heavy iron cone is then made to revolve or travel around in a circle at a rate of speed equal to thirty-five times a minute, the softening process requiring from half an hour to one hour and a half, dependent upon the condition of the hemp under treatment. Only the finest fiber is softened, the product going to the spinning mills for the manufacture of coarse sheeting, shirting, canvas, and similar fabrics, the peasantry of Brittany, for the most part, employing hemp instead of flax in the domestic economy.

Although these details relate to the manufacturing side of the industry, rather than the agricultural, they are interesting as showing by what careful means a fiber is produced in this country (France) that will take the place of linen. While on this subject it may be added

that the softened hemp is not used in its whole length, but is broken (pulled apart) into three pieces on a mechanical device for the purpose found in all hemp mills (and even in our own country). The bottom third is the best, and is kept separate for use in the finest numbers of yarn.

### THE CULTIVATION OF ITALIAN HEMP.

The best hemp which comes to this market is the Italian. Several varieties are cultivated in Italy, as already stated, though the principal variety is the Piedmontese or Bologna, the same that is grown in France.

Savorgnan states that the soil chosen for this culture in Italy is a soft, deep, sedimentary formation, and this is twice plowed in November, fifteen days intervening between the two plowings. The quantity of seed sown varies according to the soil, climate, and variety of hemp, but in Lombardy the average quantity is 200 liters per hectare, or about 2½ bushels per acre. The crop is well fertilized, but not excessively, and regard is had to economy of cost. In addition to other fertilizers, in Bologna, Professor Marconi names the following: First, manure and olive husks (after the last pressing); second, manure and excrement from hens (little used but very efficacious); third, manure and chrysalides of worms, that is, silkworms; fourth, manure and olive husks with one or more of the others. The guide for harvesting the crop is the state of maturity of the tops, which become yellow, and the white appearance at the foot of the stalks. First, the male plants are harvested, and twenty or twenty-four days later the female plants. These two operations are never retarded nor precipitated. After cutting, the stalks are removed to a shady place and the tops inclined over a sort of trestle to dry. Ten or twelve handfuls of stalks form a bundle of equal-length stems for the operation of retting.

### DRYING AND CLEANING.

The stalks are retted in water and either dried in the open air, in furnaces, or in trenches, the last practice being rarely used. Drying in the open air has advantages over any other method: First, it is less expensive; second, a superior bleaching of the fiber is secured. In the ovens the operation is hastened, and in many ways this is a very desirable system. In a perfectly dry atmosphere three to six days suffice for drying thoroughly. The stalks are again put into bundles and placed in dry locations, safe from rodents. The drying by artificial heat is done in common bread ovens, but the temperature should be very moderate; usually the hemp is introduced one hour or one hour and a half after the removal of the bread from the oven. The hemp stalks are decorticated in various ways by hand processes of beating or by machinery. The French brake, which is somewhat similar to the Kentucky brake, is little used, though a machine quite as primitive is

largely employed. In this device the stalks are first crushed, then cleaned by beating. The hemp is not ready for market when it comes from this machine, but is further cleaned, and the bits of wood, etc., which adhere to the fibers are carefully removed.

It may be stated that in favorable soils Italian hemp averages a yield of 1,700 to 2,200 pounds of dry stalks per acre, which produce from 450 to 530 pounds of fiber. "In general, 100 kilos of raw hemp furnish 25 kilos of raw filasse, and 100 kilos of ordinary filasse (fiber) give 65 kilos combed filasse and 32 kilos of tow; 100 kilos of seed furnish 27 kilos of oil." A kilo is 2.2 pounds.

In the foregoing statements it has only been attempted to outline the general practice of Italy, leaving the details to be presented in a special report on the hemp culture of Bologna and Ferrara, prepared by United States Consular Agent Carlos Gardini, of Bologna, Italy, and transmitted through the Department of State. As reference has already been made to the superiority of this hemp, an account of the methods by which it is produced, at a time when American growers are endeavoring to improve the native product by more careful culture and preparation, is a valuable contribution to the literature of the subject, and the report is therefore commended to all who are interested in the growth in America of this important textile.

## REPORT OF UNITED STATES CONSULAR AGENT CARLO GARDINI.

[Submitted to State Department from Bologna under date July 24, 1897.]

One of the most important agricultural industries of the Italian provinces of Bologna and Ferrara is the cultivation of hemp. Bologna hemp is generally manufactured into yarns for canvas and twines; the Ferrara hemp is principally worked up by rope spinners. The former has a softer and brighter fiber than the latter but not so strong; they are both, however, held in high esteem in textile centers abroad, chiefly in Germany, Austria, France, England, Spain, and in the United States.[1]

The cultivation of hemp has developed greatly in these provinces owing to the favorable conditions of the climate and soil. This plant sprouts at 8° C. (46° F.) and thrives well at 23° C. (73° F.). From its sowing to cutting for fiber the total amount of heat it requires is 2,100° C. (3,128° F.), and from sowing to cutting for seed 2,700° C. (4,892° F.). Hemp may be cultivated between the equator and 60° latitude, and when it is rationally treated no other plant gives more profit; at the same time it leaves the soil in such a good condition that the following crop (wheat) is almost marvelous.

[1] The exportation value of Bologna and Ferrara hemp certified by this consular agency from July 1, 1895, to June 30, 1896, amounted to $246,690.94, and from July 1, 1896, to June 30, 1897, to $219,475.59. But many other invoices of considerable amount of hemp of the same provinces were certified at Leghorn, Venice, Liverpool, and Hamburg by the respective United States consulates.

## ORIGIN AND DESCRIPTION OF THE HEMP PLANT.

The hemp plant, *Cannabis sativa*, is of Persian origin and grows wild in northern India and Siberia. The plants are male and female, the latter producing the seed. They have a long, white, fibril, tapered root; the stems are straight and ramified, if grown isolated, and covered with a hairy or velveted coat; height from 3 to 15 feet. Their branches grow opposite each other and bear five or seven small lanceolated leaves toothed at the margin. The female flower is sexual, almost invisible, a single cup-shaped shell longitudinally open on one side, with one ovary surmounted by two small woolly coated pins or points. The seed is in a horny bivalvular capsule or pod containing one seed. The flowers are grouped in bunches, and the seed is of a dark green color and black striped when ripe and pale green when just formed.

The male plant bears cup-shaped flowers also, the branches of which are divided into five smaller leaves and five shorter stems with oblong tetragon anthers, disposed in small bunches scattered here and there on the stems of the top leaves, ordinarily in a green cluster, and when ripe they turn yellow. The male stems tend less to branch.

The diversity of quality in hemp for yarns and canvas and that for rope does not arise from the difference in the plants, but from the results of vegetation, culture, steeping, and general manipulation. The same hemp bed will produce from the center file a good, long, resisting fiber, while from the sides of the same bed a short, hard fiber may be had, only fit for the rope spinner.

## CHEMICAL COMPOSITION.

The chemical composition of whole length of stem, according to Kane, is as follows:

| | Per cent. |
|---|---|
| Carbon | 39.93 |
| Hydrogen | 5.04 |
| Oxygen | 48.71 |
| Nitrogen | 1.74 |
| Carbonic acid | 1.45 |
| Sulphuric acid | .08 |
| Phosphoric acid | .15 |
| Chlorine | .07 |
| Oxide of calcium | 1.90 |
| Magnesia | .22 |
| Potash | .34 |
| Mineral alkali | .03 |
| Silex | .30 |
| Iron and alumina | .04 |
| Total | 100.00 |

In 100 parts of stems there is 1.74 per cent of nitrogen, while in 100 parts of seed 2.60 per cent can be extracted; therefore both contain abundant calcareous substance, especially the seed.

The following is the analysis of the ashes of the whole length of stem according to Rulling:

| | Per cent. |
|---|---|
| Potash and mineral alkali | 8.20 |
| Oxide of calcium | 42.05 |
| Magnesia | 4.88 |
| Phosphoric acid | 3.22 |
| Sulphuric acid | 1.10 |
| Silex | 6.75 |
| Carbonic acid | 3.90 |
| Chlorhydric acid | 1.60 |
| Loss | 28.30 |
| Total | 100.00 |

Hemp seed, according to analysis of Bucholtz, contains:

| | Per cent. |
|---|---|
| Fatty oils | 19.1 |
| Resin | 1.6 |
| Saccharin | 1.6 |
| Gum extract | 9.0 |
| Albumen | 24.7 |
| Woody fiber | 43.3 |
| Loss | .7 |
| Total | 100.0 |

Boussingault and Moride say the seed contains 12.2 per cent of moisture, 36.6 per cent of oil, and only 21.1 per cent of woody matter. Others say it contains 25 per cent of oil and 22 per cent of alkaline matter.

Jueymard's experiments with the seed gave:

| | Per cent. |
|---|---|
| Sulphuric acid | 34.96 |
| Oxide of calcium | 26.63 |
| Potash | 21.67 |
| Silex | 14.04 |
| Magnesia | 1.00 |
| Peroxide of iron | .77 |
| Mineral alkali | .66 |
| Sulphate of lime | .18 |
| Chloride of sodium | .09 |
| Total | 100.00 |

Leuctweis in the ashes found:

| | Per cent. |
|---|---|
| Potash | 21.67 |
| Mineral alkali | .66 |
| Oxide of calcium | 26.63 |
| Phosphoric acid | 34.96 |

## PHYSICAL CONSTRUCTION AND HEIGHT GROWTH.

The fiber is woody and lies immediately under the epidermis, which together form the bark of the stem.

Hemp growing in a wild state will not yield the fiber and kind of dressed line the Bologna and Ferrara plants do. The art of culture compels it to grow in thin, slender, erect stems, and crowded together, in order to obliterate the possibility of their branching. Isolated or wild plants on poor, badly tilled soil, do not grow to any height. In a deep, rich, and well-prepared loam, though they might reach the height of 20 feet, the stems would be rough, thick, and branchy, producing coarse, barky filaments only fit for the manufacture of rope. Good tilling and manuring is not sufficient, though. The stems, being crowded together, reciprocally shade each other, and they grow up thin and slender, yielding a soft, silky, bright, strong fiber.

The seed sparingly sown produces thick stems, especially at the root end of the plant, and will yield 15 per cent less fiber than thickly sown seed; consequently it produces broad, ribbon root ends, which are graded "rejected." This plant vegetates with success in temperate climates, and if it succeeds in moderately cold regions it is on account of there being about one hundred and fifty days of sufficient heat for its hurried vegetation.

### KIND OF SOIL REQUIRED FOR BEST RESULTS.

A rich, siliceous-calcareous-argillous loam is generally regarded as the best soil for its cultivation. The seed bed should possess this natural friable composition to the depth of about 15 to 24 inches, which is as far down as the work of digging goes after the plow has cut the furrows. Generally it is sown after a crop of wheat; sometimes it is put on to artificial grass plots, and sometimes, but seldom, it is sown year after year on the same land.

### PREPARATION OF THE SOIL.

There must be a thorough preparation of the soil to facilitate the penetration of the long, tapered roots in order to preserve a proper proportion of moisture during the hot weather, and also to clean the soil of weeds. After grain reaping, toward the end of June or beginning of July, the plot chosen for the seed bed is plowed in such a manner as to pile up the soil furrow to furrow, so that the soil of each furrow will cover a portion of land, to be plowed in turn after an interval of a fortnight; meantime, the bottom of each furrow is dug out and the soil placed above that already turned by the plow. In about a fortnight plow through the ridges over which the soil of the former two furrows was turned, and dig below the plow blade as before, turning the soil over right and left out of the newly made furrow, or trench.

In August, after a good manuring, plowing is resorted to once more to cover in. On small farms deep digging is customary. In November or December the bed or plat is leveled by means of a heavy ladder-

shaped implement with three rungs (fig. 1), drawn by oxen over the bed from end to end, after which the plat is more perfectly leveled by

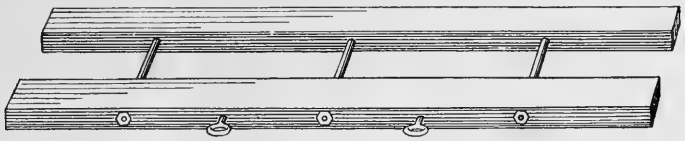

FIG. 1.—Implement used for leveling the land.

the use of hoe and spade, bearing in mind to preserve a uniform convexity of bed.

### SEED—TIME AND QUANTITY TO SOW.

Sowing commences in February or the first fortnight of March, and from 65 to 75 liters of seed is sown per hectare (nearly 2½ acres). This is covered in by the hoe, and the surface of bed nicely leveled by raking over.

A siliceous-argillous soil is well adapted for this cultivation when situated in a low, cool country. In elevated localities, if showers are lacking in May, the vegetation is sorely checked, considering the plants flower too soon. The cultivation, therefore, is not limited to any conditions of temperature, and extends throughout many parts of Europe. It depends mostly upon the conditions of the soil; when this is not deep, friable, cool, and at the same time sound, the plant will not thrive.

### AMOUNT OF PRODUCT.

The yield depends greatly on the regular and constant proportion of moisture contained in the soil. When the plant has grown to the height of 1 foot, even an extreme drenching could not harm it, unless it lasted some days. Watering is not considered essential, although it is advantageous, no doubt, in long, dry, obstinate seasons. From 20 to 26 hundredweight could be produced during a dry season by watering, where only from 10 to 12 hundredweight could be had, owing to the interruption of the plant's growth by drought.

### ALTERNATE CROPS.

Hemp alternates most commonly with wheat, the former giving the best results in rotation, inasmuch as it leaves the land free of weeds, very rich, and in such a condition that wheat may be sown to the best advantage without much dressing. On the Bologna plains the farms are disposed on a very economical system—in long, rectangular plats, with a row of elms along each side. The hemp is sown at a distance of about 12 feet on each side from the row of trees.

The following rotation of crops is recommended: Lucern for fodder, hemp, and wheat.

The following plan is given for rotation of crops. Each year on this farm of 18 fields 6 will be growing lucern, 6 wheat, and 6 hemp.

[W, wheat; H, hemp; L, lucern.]

| Fields. | Years. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | H | L | L | L | L | L | L | W | H | W |
| 2 | H | W | H | W | H | W | H | W | H | L |
| 3 | H | W | H | W | H | W | H | W | H | W |
| 4 | H | W | H | L | L | L | L | L | L | W |
| 5 | H | W | H | W | H | L | L | L | L | L |
| 6 | H | W | H | W | H | W | H | L | L | L |
| 7 | L | W | H | W | H | W | H | W | H | W |
| 8 | L | L | W | H | W | H | W | H | W | H |
| 9 | L | L | L | W | H | W | H | W | H | W |
| 10 | L | L | L | L | W | H | W | H | W | H |
| 11 | L | L | L | L | L | W | H | W | H | W |
| 12 | L | L | L | L | L | L | W | H | W | H |
| 13 | W | H | W | H | W | H | W | H | W | H |
| 14 | W | H | L | L | L | L | L | L | W | H |
| 15 | W | H | W | H | L | L | L | L | L | L |
| 16 | W | H | W | H | W | H | L | L | L | L |
| 17 | W | H | W | H | W | H | W | H | L | L |
| 18 | W | H | W | H | W | H | W | H | W | H |

## APPLICATION OF MANURE.

Although hemp, in rotation with wheat, leaves a powerful fertilizing matter in the fields, maize should never follow a wheat crop to be followed in turn by hemp, unless the land is richly manured. As before stated, the hemp plant is most exhaustive to the soil in cultivation, but it gives back by its residues a large proportion of fertilizing material, especially when it is realized that a considerable quantity is deposited in the steeping pits, which must be cleaned out and the mud spread over the fields, supplying an excellent manure. The quantity of manure required per hectare is about 30 tons; less is required when the hemp fields have once been well prepared. In the Bologna district manuring is done in a very systematic and rational manner. The farm manure is well mixed under the lowest stratum of soil; then the other manures are worked into the medium stratum, and, last of all, before sowing, in order to increase its richness, hen manure or oil cake refuse is spread over the surface. Experience has shown that manuring by penning sheep on the land at night gives most excellent results.

Several kinds of manure may be used, such as soot, which is advantageous in destroying the parasitical weed *Phelipea ramosa*, a fatal pest to the hemp. Oil-cake refuse, or any oily residual matter, is excellent for producing good line. Hoofs or feathers are considered the best—hoofs for soil where silex abounds, feathers for a hard, substantial loam. Night soil is as efficacious as the droppings of fowls. Guano is advantageous when scattered over the surface of the field

and worked in with the hoe just before sowing. Hair (animal), cotton and woolen rags, besides the mud taken from the steeping pools and left in a heap for some months, are all excellent surface manures. Beans, too, are sowed and plowed into the soil at maturity.

Manures should be applied as follows:

(1) To the lower stratum of soil. (2) Over the furrows, which are then covered. (3) Scatter the last manuring over the hemp field and work in with the hoe shortly before sowing.

*Table showing quantity of manure to allot per hectare.*[1]

| | Lower stratum. | Medium stratum. | Superficially. |
|---|---|---|---|
| I | Farm manures ..... tons.. 20 | Bean stalks ..... tons.. 6 | Hen manure ..... cwt.. 5 |
| II | .....do ..... do... 20 | .....do ..... do... 6 | Guano ..... do... 4 |
| III | .....do ..... do... 20 | Feathers ..... cwt.. 6 | Hen manure ..... do... 5 |
| IV | .....do ..... do... 10 | Bean stalks ..... tons.. 6 | Oil-cake refuse ..... do... 20 |
| V | .....do ..... do... 10 | Hoofs ..... cwt.. 12 | Hen manure ..... do... 5 |
| VI | .....do ..... do... 10 | Night soil ..... tons.. 3 | ..... |
| VII | .....do ..... do... 10 | Oil-cake refuse ..... do... 1 | Hen manure ..... cwt.. 2 |
| VIII | ..... | .....do ..... cwt.. 32 | .....do ..... do... 5 |
| IX | Farm manures ..... tons.. 20 | ..... | Oil-cake refuse ..... do... 8 |
| X | .....do ..... do... 10 | Animal dried blood.. tons.. 2 | |

[1] A hectare is about 2½ acres.

Five tons of bean stalks (calculated as dry) contain about 3 hundred-weight of nitrogen, equal to 16 tons of farm manures.

The fields manured as to I, II, III will do well for wheat crops in succession, being rather strong; VIII is weaker.

Fertilizing substances, containing nitrogen or phosphates alone, check the vegetation of hemp; therefore the best manure is considered that produced on the farm.

The fields, ordinarily 90 yards long by 40 broad, should be nicely raked and dressed, so that they will be slightly convex.

Cart, scatter, and bury the fertilizer for the first manuring in August, and sow the beans at once if considered necessary. In November plow and dig up under the furrows, covering in the bean stalks, if sown. Weather permitting, hoe, weed, and cover over the superficial manure in February, remembering to dress the soil when almost dry, thoroughly working in all the bean stalks.

## SOWING THE SEED.

Having prepared the soil during winter, it is an easy matter to dress for sowing. The seed should be a gray-green, black-striped, brilliant color, and so heavy as not to float on water. Black or whitish colored seed must be discarded, not having been ripe when gathered. Sixty-five to seventy-five liters per hectare (or approximately 1½ to 2 bushels per acre) are sufficient when there is quality.

Mark off the fields into beds about 8 feet wide. The seed is sown broadcast early in March, and this operation should be intrusted to

those who have a thorough knowledge of the crop and an interest in the result of the harvest. To have portions of land sparsely covered and others too thickly covered will cause much irregularity and reduce the commercial value of the fiber produced.

### HOW TO TEST THE QUALITY OF SEED.

To ascertain if the seed is in good condition and containing all its germinating properties, break open a few of them. If they have a musty, oily taste, the seed is old. Seed three years old will not sprout. When the farmers have any doubts about the quality, they count 100 seeds and sow them in a flowerpot, keeping the soil damp and placing the pot in the warmest nook in the stable. In eight or ten days the seed will sprout; 90 per cent of sprouts indicates a first-class quality of seed; 70 to 80 per cent, fairly good. By this means it is possible to estimate very closely how much to sow to obtain an even growth over the field. Some sow by machinery with good results, the practice also saving seed.[1]

### WEEDING THE CROP.

Favorable weather and a temperature of 10° C., with sufficient moisture, will enable the young plants to appear in five to eight days, after which it is advisable to weed. In a wet spring weeding is resorted to three or four times. When the plants are about 2 inches high, bearing two leaves, it is necessary to weed with the so-called weeding hoe (fig. 2). Repeat this operation when from 5 to 8 inches high.

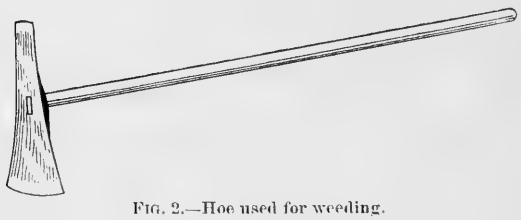

FIG. 2.—Hoe used for weeding.

### PRODUCTION PER HECTARE.

If too thickly sown, when about 4 feet high the plant stops growing and begins to lose its dark-green color and flowers. When rationally treated this plant will stop growing only for want of moisture in very dry seasons, yielding from 20 to 26 hundredweight of fiber per hectare, tow and rejected included. The green stalks, when ready for cutting, weigh from 19 to 30 tons. The loss in drying and casting of leaves is from 30 to 35 per cent. Approximately, 19 tons will be the

[1] Improved machines of American make are not known to the majority of farmers. The writer has several times suggested that it would be to the advantage of the manufacturers of American agricultural implements to be represented at Milan, Bologna, and Naples, in order that the farmers of these large agricultural centers might become acquainted with these superior implements.

entire weight of the vegetable mass when ready for cutting, as will be seen by the following:

| | Tons. | Cwt. |
|---|---|---|
| Loss in drying | 6 | |
| Leaves, roots, tops, etc., left on the field | 5 | |
| Fertilizing matter deposited in the steeping pit from the sorted stalks | 3 | 5 |
| Sticks, about | 3 | 3 |
| Seed | | 2 |
| Fiber, including tow and rejections | 1 | |
| Total | 19 | 00 |

### NEED OF RICH NOURISHMENT.

Comfort and abundant nourishment in animal life hasten puberty—the contrary to what takes place when in a wild state, and when growth is stunted. Vegetable life, on the contrary, presents in this respect a decided contrast. Substantial and abundant nutriment tends to retard development of the generative properties, and the plant blooms later, and later still produces seed; therefore when the hemp plant in its infancy finds itself in unfavorable and stinted conditions, it flowers and seeds very soon. This will occur also when too thickly sown, which defect deprives it of sufficient nourishment and space to spread its roots.

### EFFECT OF HOT AND WET WEATHER.

When the stalks show signs of rusting after alternate days of wet and hot weather, it is advisable to hurry the cutting. Drops of water on the plants evaporate by the sun's action, leaving black or red spots, which damage the fiber. After it is 12 to 14 inches high little attention is needed until it reaches maturity. At this height the plants cover the soil, protect it from the sun, and thus preserve it cool, besides suffocating the ever-obstinate reproduction of weeds.

### A PARASITE.

*Phelipea ramosa* (a vegetable parasite of the honeysuckle species) is a fatal enemy to hemp. It germinates on its roots, depriving them of nourishment and causing the plants to flower very soon. This parasite grows pods full of very small seed, which preserve their germinating properties for years. To extirpate this destructive parasite it is indispensable to change the rotation of crops for a few years, or to cut the hemp as far down as possible before the parasite flowers. Very appropriately, the Germans call this terrible weed *Hanfmurder* (the hemp murderer).

### WHEN AND HOW TO CUT THE CROP.

Cutting begins toward the end of July or early in August, when the male plants throw off a dusty substance, the best time being during the course of change from dark-green to a light-brown color and before

the stalks become yellow. This, however, must be determined according to circumstances and practical experience. The farmer cuts the stalks with a kind of scythe (fig. 3), by taking an armful under his left arm and between it and his body, cutting with the right just above the surface of the bed, and then laying them across each other diagonally until a sheaf is complete. A portion of the best of the female plants is left growing to produce seed. When the stalks have lain a day or two in the sun they are turned over, and when dry the sheaves are taken up and beaten on the earth to strip them of their leaves. The stalks are then set up on their root ends, so as to make conical-shaped stacks about 9 feet in diameter at the base, which are left standing a few days to further dry and season.

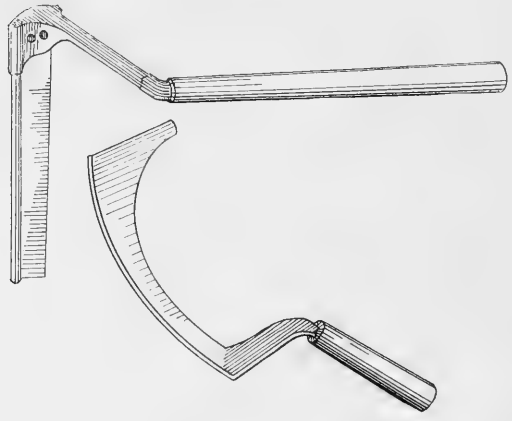

FIG. 3.—Scythes for cutting stalks.

DRYING AND SORTING THE STALKS.

The steeping or retting process is quicker when the stalks are not altogether dry, but, by thoroughly drying, many inconveniences are avoided.

Before steeping all the several lengths of stalks are bunched together by sorting. In wet weather never allow the sheaves to lie on the field, otherwise a black, unsound fiber will be produced.

The stalks, being perfectly dry, are carried to a shaded locality on the farm and laid on an inclined bench with all the root ends together. They are then evened up with a broad-faced mallet, so as to make an even vertical surface. When the bench is sufficiently full a very heavy beam of wood is placed across to maintain pressure; then the operation of sorting commences. The farthest projecting stems are drawn out by taking hold of the tops and pulling horizontally. A large handful of these, being then held perpendicular, root end down, resting on the ground, are tied up about 1 foot from the root end and 2 feet from the tops with a thin green hemp stalk, a bundle of which is near at hand for that purpose. This operation is carried on until the bench is drawn. Thus the long, thick, medium, and short fiber becomes sorted, besides separating the rejected. For this operation all leaves, branches, and any weeds must be stripped off.

The bundles of stalks are made up of twelve to fourteen sheaves, one over the other, the roots and tops placed end to end, the latter projecting, so that when tied up with green hemp stalks, as before, they form

a somewhat cylindrical bundle. After the bundles are made up the projecting tops are cut off square to the root ends. If the bundles were not made up in this manner they would be difficult to cart and would give less uniformity during the steeping process. Stalks so bundled can be stored year after year in dry warehouses without fear of damage.

Twelve sheaves, that is, one bundle, of good hemp will yield 4½ pounds of fiber, though this depends on length and quality.

### CARING FOR SEED.

About a month after cutting for fiber the female plants that were left to ripen will be ready. They are cut carefully, so as not to lose the seed, dried in the sun, well seasoned, the seed sifted, sacked, and kept dry.

The female stalks, owing to the advanced season, are very often dried, to be kept until the following year. Good seed is plump and glossy and feels damp; it is white in color, with small black markings. When the inside is black it has been damaged by fermentation; if dusty, it is old and too dry, and therefore not serviceable. A good quality of seed when rubbed between the hands becomes glossy; if dropped on red-hot iron it cracks and bursts.

### RETTING THE STALKS.

The structure of the bark of the stems shows that retting or steeping is absolutely necessary. Each stalk is composed of a woody tubular structure, around which clings a network of longitudinal filaments, bound together by a substance insoluble in water. By steeping a sort of decomposition is induced, through which the intercellular matter is rendered soluble. Thenard and Orfila found by experiments that the bark is composed of vegetable fiber, resin, green coloring matter, and glutinous sap, by which substances it sticks to the stalk. In the operation of retting the last two become putrified.

Fermentation damages the fiber, but the fiber resists the action longer than the binding ligaments, consequently the retting process consists in allowing the hemp to decompose these substances without injury to the filament. The fiber, according to Girardin, is under the epidermis and bound to the woody cylindrical stalk by means of a resinous gum, so that it can not be extracted unless separated by fermentation, which action rots the binding ligaments.

Hemp must be steeped in stagnant water, about 10° C., which has been standing in the steeping pools at least a month to purify and become aerated, so that it will not injure the fiber. The steeping or retting process is more or less rapid, according to the temperature of the water as affected by the sun, according to the nature of the water, the kind of weather, and the quality of the hemp itself.

In hot weather, when possible, after the first steeping it is best to draw or run off about a foot of water and replenish with fresh.

There are two forms of retting or steeping pits, one fitted with stakes (fig. 4), the other with rows of stones (fig. 5). In each of these pits two rettings are effected in succession by sinking the bundles of stalks four layers deep in the stake steeping pools. The first steeping takes about eight days, the second a little longer; but, during the second steeping, if the water gives signs of "ebullition" the hemp must be taken out immediately.

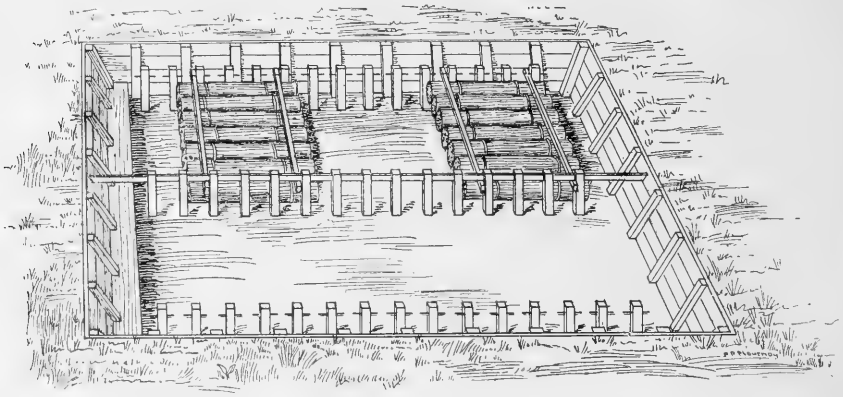

FIG. 4.—Stake retting pool.

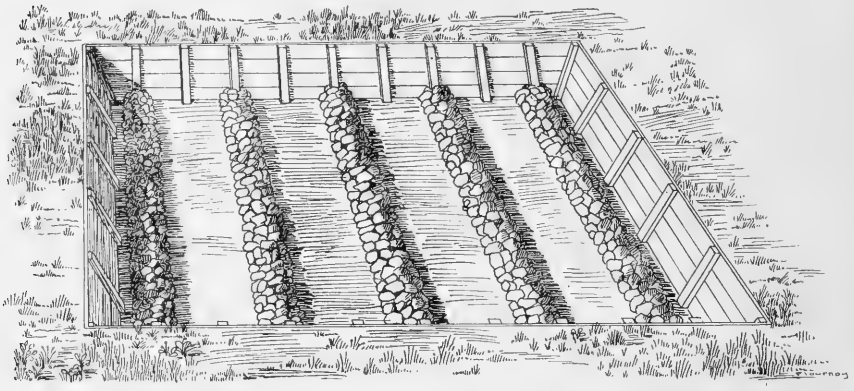

FIG. 5.—Stone retting pool.

If the fiber can be removed from the surface of the woody portion of the stalk by passing it between the finger and thumb it may be concluded that the operation is complete; or if, by bending a stalk, the woody part starts from the fiber, it is clearly in a condition to be taken out of the water.

Large steeping pits are preferable. The depth should not exceed 5 feet, to allow the water to be at an approximate uniform temperature from surface to bottom. The height of the water above the sunken hemp should never be under 12 inches in any retting pool.

STAKE RETTING POOL.

Fig. 4 is a stake retting pool, showing hemp bundles under submersion. The ground around these should slope inward, the sides inclined to about 45 degrees, and should be lined with oak planks 1½ inches thick.

At one side of the stake steeping pool make a platform, so that the laborer when steeping, taking out, and washing will not have the water much above his waist. The bottom should be made level, slightly inclined to the drain. There are two rows of square stakes, standing up to water level, along the length of the pit, to which horizontal wooden spars are nailed, top and bottom. Under the top horizontal spars, running from end to end, long wood levers are inserted to sink the bundles.

STONE RETTING POOL.

It is best to build the stone steeping pools with brick walls. The bundles in this kind of steeping pit are sunk by tying them together and loading with stones taken from the rows. These pools should not be more than 3 feet deep; this system is handy when there is little or no means of drainage. When the steeping is finished, the pools are left to dry up or are pumped out and the stones placed again in rows distant from each other the length of the bundles. In a stone steeping pit one man arranges the bundles in layers, holding them together by means of a rope, while a second man holds the rope at the other end and walks backward to the opposite side of the pit as the bundles are put in, and until the range of bundles is complete. This range is then tied up and sunk by heaping on stones taken from the bottom of the pool.

DRYING THE STALKS.

After five or six days' steeping, take a sheaf from the pit, wash it, open it out, and stand it on the grass, roots down, in conical-tent shape, to dry in the sun. If, when dry, the color and strength are satisfactory, all the other bundles should be taken out the following morning. A night longer in the pit does no harm, owing to the low atmospheric temperature. The range of bundles is untied, the bundles opened, and each sheaf carefully washed, thrown out, and set up, root end down, in large pyramidal sheaves, to drip for about twelve hours, in which condition the fiber gains in color and loses a great deal in weight, in case it has to be carted anywhere for drying.

The sheaves are then opened out, in the form of conical tents, to dry.

Should it rain during the drying period, the fiber loses part of its gloss and contracts a roughness, which is perceived by the touch.

Always open out to dry on closely cropped grass land, to avoid splashing with mud. When dry, tie the hemp again in bunches and store, remembering that if not perfectly dry the fiber will rot.

## SCUTCHING AND CRUSHING.

The next operation is scutching and crushing. To reduce the fiber to a marketable condition the most simple, strong, and economical machinery is required. The compound scutcher and crusher is most commonly employed. The hemp is scutched by gradually pushing sheaves under the scutching blades, roots foremost, and then through the crusher, which has a pair of fluted cast-iron rollers, one above the other, working closely together. The sheaves are fed in without the application of any traveling apron or feed arrangement. The top roller is heavily weighted, so between it and the bottom one the crushing is accomplished. The first operation roughly breaks the sticks, thus disintegrating them from the fiber.

When scutched all its length, the man feeding the scutcher hands the "streak" to a man on his right, who breaks up the thin sticks at the tops, shakes the fibers well in order to allow the broken fragments to drop, gives the streak a twist about the middle and lays it in a heap, while a man on the scutcher's left hands him another sheaf to run through. Two gangs are generally employed, one scutching, the other crushing, shaking, and tossing the streaks coming from the crusher, to get out all the woody matter possible.

After scutching and crushing the hand beater is very often employed to improve the quality of fiber by further separating its tissues; it gets spread more equally, and becomes softer and more brilliant.

## FINISHING TOUCHES.

Scutching, crushing, and beating over, the most intelligent men on the farm are chosen to give to the fiber the finishing touch.

The streaks are taken one by one, the black fibers drawn out, along with any thick root ends, and all nicely matched by sorting and putting together all hemp of the same length. On a clear night these streaks are taken from the store and spread on the grass to absorb a little dew, which is very beneficial, though care must be taken never to drench it, otherwise the fiber will rot. Each streak is then folded in two and twisted at the middle to avoid mixing and becoming ruffled. They are then put carefully on a low platform of planks, layer upon layer, so as to make up the so-called "parcel."

If hemp has to be stored any length of time, it is advisable to bale it, avoiding thus any serious damage in case of fire. The bales weigh from 300 to 400 pounds.

Fig. 6 represents a Bologna farm of 11 hectares, 2 of which we must suppose are taken up by buildings, farmyard, steeping pit, roads, and walks. Each field is 125 meters long by 40 wide (one-half hectare, or about an acre and a fourth). SS and SS are the roads, and Z the steeping pit.

C, B, and A are the three ranges of fields, first, second and third. Suppose the range C is on hemp cultivation, range B on lucern grass, and range A on wheat. The first field or bed of range C at the corner Z will be No. 1, the next No. 2, and the last No. 6, all on hemp cultivation. The first bed of range B will be No. 7, the last No. 12, all growing lucern, including the two beds Nos. 9 and 10, portions of which are built upon. No. 13 will be the first bed of the A range, the last No. 18, all growing wheat.

Where there are rows of trees, neither hemp nor lucern is sown within 12 feet of them, including the drains. Potatoes and turnips are grown under the elms.

If this plant suffers a hailstorm in its infancy, no matter how light, it is advisable to hoe up and sow again. If visited by a disaster of

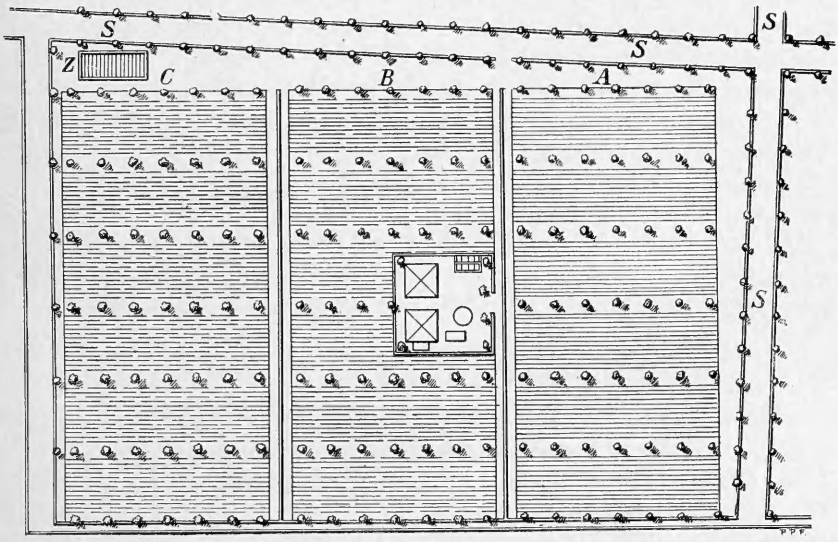


FIG. 6.—Bologna hemp farm.

this kind in June or July, cut and steep immediately. By allowing it to grow, more will be lost than gained, both in quality and quantity. The surface of hemp beds becomes crusty if heavy rains follow sowing, consequently the seed sprouts with difficulty. After sprouting, the same heavy showers will damage it most fearfully by splashing; the mud will stick to the leaves and stalks and choke them. Heavy winds beat the stems together and bruise the epidermis, leaving a very visible mark on the fiber. Sometimes a crop is partly destroyed. If the plant does not get enough rain early in June, it will not yield much fiber. Hemp has enemies, also, among the insects; some devour the leaves, the *Phordon cannabis* destroys its seed, and, above all, the *Botys silacealis*, which eats through the stalks, nourishing itself upon the marrow therein.

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